REMARKS

Claim Status

Claims 49, 50, 52-63, 65-67 and 86 are currently pending. Claims 1-36, 38-48, 64 and 68-85 are withdrawn. Claims 37 and 51 are cancelled.

Applicants note that the withdrawal of Claim 64, 68-75, and 79-84 is subject to non-allowance of the linking (generic) claims, namely Claims 49. According to M.P.E.P. §§809 and 804.01, the linking claims must be examined with the invention elected, and should any linking claim be allowed, the restriction requirement must be withdrawn. Accordingly, should the elected species be found allowable in view of the traversal of the rejection of Claim 49 under 35 U.S.C. §103(a), below. Applicants request that the Examiner examine the linking claim (Claim 49), and, if allowable, the claims to non-elected species, such as the species of Claims 64, 68-75, and 79-84.

Advisory Action

The Examiner maintained the previously advanced rejection of Claims 49, 50, 52, 56-63, 65-67, and 86 under 35 U.S.C. §103(a) as being unpatentable over U.S. 5,566,387 ("Dewald") in view of Jang *et al.* "Holographic Data Storage by Combined Use of Peristrophic, Angular, and Spatial Muliplexing", Opt. Eng. 39(11), pp. 2975-2981 (November 2000).

The Examiner stated that while Dewald fails to teach azimuthal multiplexing, Jang discloses the combination of angle and peristrophic (azimuthal) multiplexing techniques. In response to Applicants' arguments presented in the Reply to Final Office Action, filed on March 19, 2008, the Examiner stated that the Office is *not* relying on the specific teachings of Jang's preferred embodiment, but rather on Jang's general teachings of implementing a combination of multiplexing techniques by using wedge prisms rotatable around two axes. The Examiner also stated that Jang discusses the use of a galvanometer-based x-y optical scanning system in which the beam direction is controlled by "two properly tilted mirrors".

It is Applicants' understanding that the Examiner's position is that (1) Jang teaches that combination multiplexing can be implemented by rotating *optical elements* (either two mirrors or two wedge prisms) about two different axes; and (2) the teachings of Jang are sufficient to

motivate one of ordinary skill in the art to modify the device of Dewald to allow for combination multiplexing. If Applicants are incorrect, clarification is requested.

Applicants' Response

Embodiments of Applicants' invention relate to a holographic recording apparatus that implements combined multiplexing techniques. The instant invention is based on an innovative optical architecture design that implements combined multiplexing and is capable of employing just one movable reflecting surface. (See the figures, *e.g.* FIG. 1.) In other words, Applicants invented *a specific mode of employing movable mirrors* to implement *combined multiplexing.* Whether or not there existed, at the time when the instant invention was made, other devices (*e.g.*, the device of Jang) that may employ combinations of movable optical elements that could implement combined multiplexing does not deny patentability to the Applicants claimed device.

Applicants' claimed device possesses advantages over the devices of Dewald and Jang. Namely, Applicants' device employs a simplified optical architecture and may be constructed using a single rotatable element (either an elliptical mirror or an additional mirror). Moreover, neither Dewald nor Jang motivate one of ordinary skill in the art to construct a device that implements combined multiplexing using reflecting mirrors rotatable about two axes.

Advantages of Applicants' Device

In addition to being able to implement combined multiplexing, unlike the device of Dewald, Applicants' inventive optical architecture is also technically and materially simpler than the device of Jang.

Claim 49 recites that an embodiment of a device of the present invention comprises "at least one portion of an aspherical reflecting surface having two focal points"; "at least one additional reflecting surface"; and "a motive device for rotating *at least one of either* at least one portion of the aspherical reflecting surface or the at least one additional reflecting surface about a first axis and, independently, a second axis, perpendicular to the first axis" (*emphasis added*). Thus, Applicants' device can work using only *one* movable part (*e.g.*, mirror M1 in FIG. 1A). While the device of Dewald cannot implement combined multiplexing at all, the device of Jang (the only cited reference that describes a device capable of implementing combined

multiplexing) employs *two* movable parts (either wedges or, allegedly, mirrors that would replace the wedges).

Furthermore, Applicants' device employs an optical architecture that is simpler than that of Jang. To illustrate their point, Applicants invite the Examiner to consider any of the devices described in Jang and shown in FIGs. 2(a)-(c). The device of FIG. 2(a), having two wedge prisms, SLM and lens elements L4 and L1(L2) for recording, requires a special coaxial lens L1(L2), in which the central portion accepts the signal beam from the SLM, and refracts the signal beam differently from the light incident on the peripheral portion (so that the SLM-encoded signal beam, passing through the center of the lens, would be focused at the same storage location as the reference beam, passing through the peripheral portion of the lens. Moreover, lens elements L4 and L1(L2) must be critically aligned in a 4f optical imaging configuration with the pair of wedge prisms, which, in turn, must be critically aligned with respect to each other and the recording medium (otherwise the reference beam angle will not be redirected to the same location in the recording medium during planar angle and/or azimuthal multiplexing). Additionally, lens element L1(L2) and L3 must be critically aligned in a 4f optical imaging configuration with the SLM, the recording medium and the CCD detector (otherwise the reconstruction light from reading multiplexed holograms will not be properly imaged onto the CCD detector). Thus, the multiplexing device of Jang in FIG. 2(a) requires an optical system comprising two 4f optical subsystems wherein their respective critical alignments are also further complicated by their interdependence .

The device of FIG. 2(b) also requires a difficult to manufacture and difficult to maintain 4f optical imaging arrangement of lenses L4 and L1 that would permit the beam redirected by the steering mechanism (the two movable wedges) to be properly directed at the photorefractive crystal to ensure desired co-locational multiplexing. Similarly to the device of FIG. 2(a), the device of FIG 2(b) also requires critical alignment of a second 4f imaging system for the signal beam, comprising SLM, lens element L2, photorefractive crystal (recording medium), lens element L3 and detector CCD. Moreover, the alignment of the photorefractive crystal (recording medium) is interdependent with the 4f imaging system for the reference beam.

The device of FIG. 2(c), in addition to a pair of movable wedges, includes *two* parabolic mirrors critically aligned with respect to each other and to the pair of movable wedges. The

device of FIG. 2(c) further requires a complex Fresnel lens L1, which must also be critically aligned with respect to the two parabolic mirrors and pair of wedge prisms as part of the reference beam imaging system. The device of FIG 2(c) further requires a 4f imaging system for the signal beam (SLM, lens element L2 inside center of Fresnel lens L1, recording medium, lens element L3 and detector CCD). Thus, the optical architecture depicted in FIG. 2(c) is especially technologically complicated.

In contrast, embodiments of the Applicants' device (see, *e.g.* FIG. 1A of the instant Application), do not require difficult to manufacture lenses, hard to maintain optical imaging arrangements requiring interdependent alignment of several subsystems, or multiple mirrors arranged in a Cassegrain telescopic structure (as in FIG. 2(c)). Applicants' inventive devices employ much simpler optical architecture and, advantageously, permit implementing combine multiplexing using a single movable mirror.

Dewald and Jang Fail to Motivate

Applicants submit that neither Dewald nor Jang teach ***how*** to implement combined multiplexing using one elliptical mirror and rotatable mirrors. Dewald is devoid of any teachings of multiplexing or any suggestion of how to build a device in which an additional mirror would rotate around two axes. Jang does mention that two mirrors could be used to steer the beam instead of the two depicted movable prisms, but does not show how this is done. Furthermore, a close inspection of the portion of Jang referenced by the Examiner as disclosing the use of two mirrors (Jang, p. 2976, right column, second paragraph) shows that Jang is actually arguing *against* the mirror-based beam-steering system. Jang states that the wedge prism-based mechanism is simpler, does not affect beam polarization, and is more compact than a mirror-based system, which employs x-y galvanometer. Thus, Jang would motivate one of ordinary skill in the art *against* modifying his device of the device or Dewald to employ movable mirrors. Moreover, even if one of ordinary skill in the art, going against the express teachings of Jang were to use two mirrors, neither reference would provide any guidance as to ***how*** to make such a modification.

Applicants note that mechanical replacement of the wedge prisms of Jang, that are transmission optical elements which refract light, with two movable mirrors that reflect light not

only results in a device different from the one claimed by Applicants (no elliptical mirror; two rotatable mirrors required), but, as Applicants previously argued in their Reply After Final Rejection (March 19, 2008), the use of the movable wedges with elliptical mirrors results in an inoperative device. In other words, a mere statement in Jang that *two* mirrors *can* be used to steer a beam does not amount to a suggestion to use an elliptical mirror and an additional mirror, of which only *one* mirror is movable. These elements, however, are recited in Claim 49.

Summary

Neither reference suggests using a combination of an elliptical mirror and an additional mirror, of which only *one* mirror is movable to implement combined multiplexing. This, however, is *an advantage* of Applicants' invention. A mere suggestion in Jang that *two* movable mirrors can be used, does not amount to a suggestion to use an elliptical mirror and an additional mirror, of which only *one* mirror needs to be movable. Moreover, Jang expressly argues *against* employing movable mirrors at all.

Moreover, as Applicants argued previously, the combination of the references of record fails to teach all the elements of the Applicants' claimed device (an elliptical mirror and an additional mirror, of which only *one* mirror need to be rotatable around two perpendicular axes), and fails to suggest or motivate the modifications necessary to arrive at the Applicants' claimed device (no teaching of *how* a combination of an elliptical mirror and an additional mirror, of which only one mirror need to be rotatable can be used to implement combined multiplexing).

CONCLUSION

In view of the above amendments and remarks, it is believed that all claims are in condition for allowance, and it is respectfully requested that the application be passed to issue. If the Examiner feels that a telephone conference would expedite prosecution of this case, the Examiner is invited to call the undersigned.

Respectfully submitted,

HAMILTON, BROOK, SMITH & REYNOLDS, P.C.

By Alexander Akhiezer

Alexander Akhiezer
Registration No. 54,617
Telephone: (978) 341-0036
Facsimile: (978) 341-0136

Concord, MA 01742-9133

Date: 6/18/03